wards towards the Throssell Range. As we approached a creek system with scattered gums my vehicle disturbed four parrots from the spinifex. Only my brother (R. D. Ives) in the following vehicle saw the birds. They were bright green, about the size of a Mulga Parrot but heavier in build. They flew swiftly and very low (just clearing the tops of the spinifex) for about 25 yards before dropping from view. Half an hour's search failed to find them. No calls were heard.

This second area had evidently received some patchy rain. Where the birds were flushed there was a few hundred acres of spinifex in seed. No surface water was found in the immediate vicinity, but there is a large rockhole four miles northwards in the Throssell Range. The perennial vegetation consisted almost solely of spinifex, apart from the belt of scattered gums which we were about to enter.

I have discussed these observations with Dr. G. M. Storr of the Western Australian Museum who, believing they almost certainly apply to the Night Parrot, has urged me to publish them.

AN EXPLORATORY INVESTIGATION OF THE GROWTH RINGS OF *CALLITRIS PREISSII* TREES FROM GARDEN ISLAND AND NAVAL BASE

By G. I. PEARMAN, Department of Botany, University of Western Australia, Nedlands, 6009.*

Analysis of growth rings in trees has been used extensively in the northern hemisphere in order to determine the age of timber of archaeological interest and of trends in past climate. As the growth of the timber is dependent on a large number of environmental factors it is not surprising that a correlation can be demonstrated between the width of growth rings and parameters such as rainfall and temperature. It is also evident that, because of the complexity of the interaction of influencing factors, the correlation with any one factor is not necessarily very high. For a discussion of this and other aspects of the sciences of dendrochronology and dendroclimatology the reader is referred to Fritts (1965, 1969).

Preliminary measurements of the growth ring widths of *Callitris preissii* Miq. were made by students during the 1969 Botany Department field camp at Garden Island. These results proved to be encouraging and the author carried out further measurements on trees of the same species on the adjacent mainland at Naval Base. The aims of the investigation were to determine the suitability of this species for growth ring studies; to make estimates of the age structure of the stands in the two locations; and to determine whether cyclic patterns of wood growth are present which might act as indicators of past climatic conditions in the area.

METHODS AND RESULTS

An increment corer was used to extract cylindrical cores of timber (approximately 4 mm diameter) from twenty trees growing on the north end of Garden Island, and twelve trees at Naval Base. The cores were removed from the trees about 50 cm above soil level, and following removal the holes were plugged with wooden pegs soaked in fungicide. The cores were placed on the stage of a sliding microscope so that measurements could be made of the width of individual growth rings (measured to 0.005 mm). It was found unnecessary to apply any special treatment to see the rings distinctly.

In order to best display the general trends indicated by the results, the data were smoothed. The smoothed width of a ring of measured width b was taken as $\frac{1}{4}(a + 2b + c)$ where a and c were the measured widths of the immediately adjacent rings.

It is usually found that the width of growth rings decreases towards the outside of the trunk, and this was demonstrated in the case of the

* Present address: C.S.I.R.O. Division of Meteorological Physics, Aspendale, Victoria.

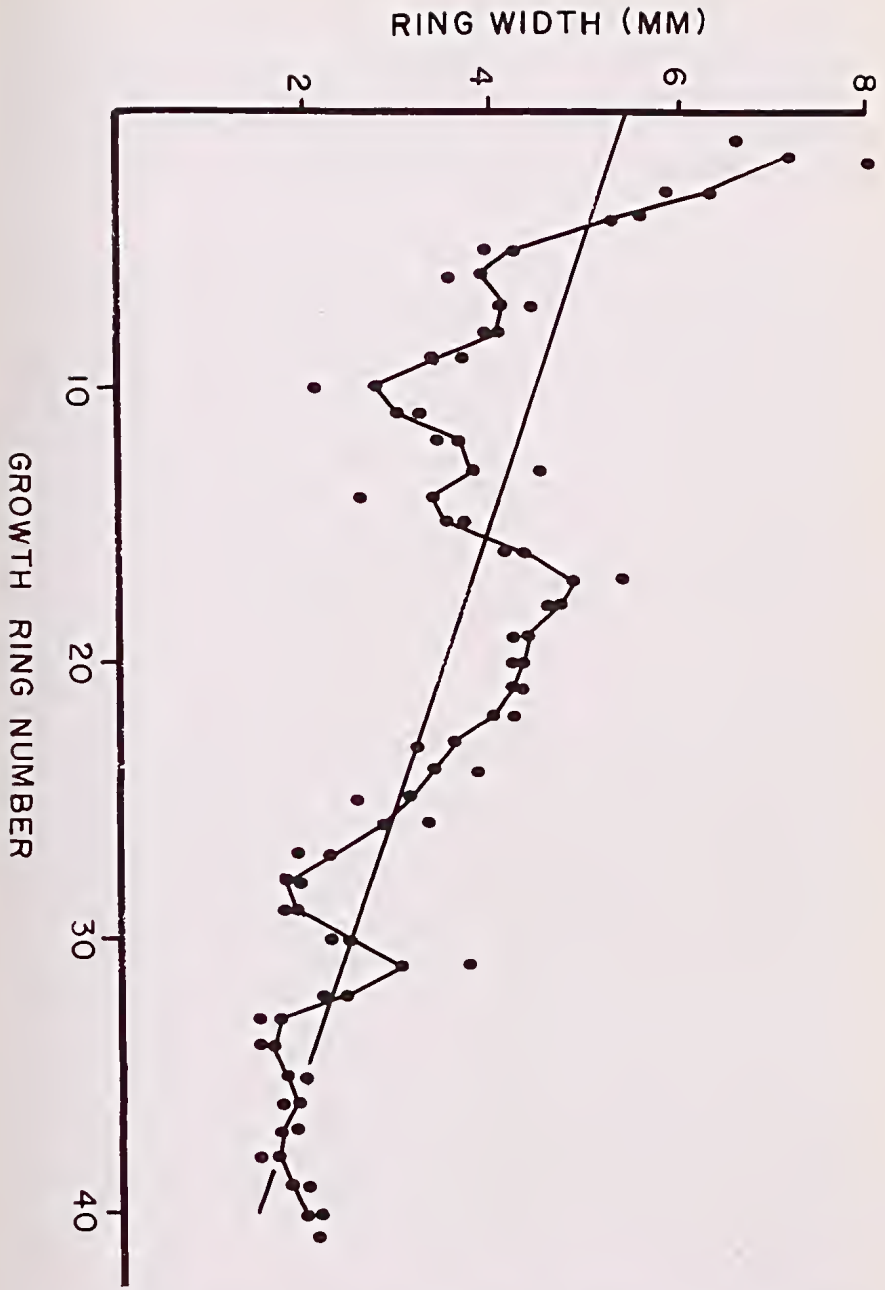

Fig. 1.—Growth ring widths for one core taken from a tree growing on the north end of Garden Island. The figure shows how the smoothing technique influences the data and the way in which there is a general decrease in ring width towards the outside of the trunk.

Garden Island trees (see Fig. 1). To facilitate the recognition of cyclic patterns in the ring widths, the "best fit" linear regression line was calculated for the data for five cores from Garden Island. The results were then plotted as deviations from the regression equation against ring number (estimated date). See Fig. 2. The data from the Naval Base cores did not show this general decrease in width with radius, and therefore they were plotted after smoothing, but simply as growth increments against time (see Fig. 3 for data from five Naval Base cores).

DISCUSSION

It is important to note that, while the data have been plotted with the abscissa in Figs. 2 and 3 representing a linear time scale, at this stage we can not be sure (as to the reliability of the assumption) that each growth ring represents one year of time. Lange (1965) has indicated that *Callitris columellaris* trees near Woomera appear to have produced two rings in some years and none in others, the number of rings varying by about twenty in eighty years for the three trees considered. Fritts (1969) emphasises the care that must be taken in the selection of the trees that best indicate a record of the past conditions. At one extreme, if the tree comes from a part of the forest where conditions are nearly always optimum, then little growth variation will occur from year to year. However, if one selects trees from the fringe areas where they are under environmental stress, then they are more likely to produce a climate-dependent growth ring pattern, but also likely to miss producing a ring in a poor season. It should be remembered therefore that comparison of the curves for different trees should be made only on the basis of a flexible time scale.

Future studies should involve careful cross checking of the peaks and depressions of growth in different trees both with each other and with the local weather records. In this way it should be possible to indicate the best area from which to take cores. It is also possible to get additional information about the growth ring produced in any one year by measuring density changes across the ring, which can be obtained from an X-ray plate of the core. Using this recent technique it is often possible to characterize a given year by the density distribution in the corresponding growth ring (Dr. P. Rudeman, personal communication). If the growth patterns of *Callitris columellaris* as indicated by Lange (1965) are taken as an indication of the reliability of dating from individual trees, then we can expect the actual estimated ages of the trees to be within 25% of the true value, and most likely better, considering the extreme climatic conditions at Woomera as compared with those at Perth.

From Fig. 2 it can be seen that, even allowing for such a possible error in the indicated age of the trees, the Garden Island trees cannot be much more than 50 years old. The Naval Base cores appear to fit into two definite groups, one represented by curves 1 and 2 where both trees showed precisely the same number of rings (first ring estimated at 1873), and the other represented by curves 3, 4 and 5 where the number of rings was similar (first ring estimated at about 1923) although some inner rings were indistinct. It had been hoped that the trees would have been found to be 200-300 years old, and thus able to provide much more information. The data presented here, and the additional cores that were examined, indicate that the western stands on Garden Island are of the order of 50-60 years old with some younger stands of an age that suggests that they may have developed after the fire that devastated much of the Island in 1955. The Naval Base data indicate two age groups: one approximately 100 years old, and the other approximately 45 years old. It is impossible to say at this stage whether older trees exist in these stands. Observations made on the girth and height of trees throughout the areas are of little use in predicting age. Trees that proved to have approximately the same number of growth rings were found to have trunk diameters that varied by 200-300%, depending mainly on the density of the stand in which the trees were growing. Cer-

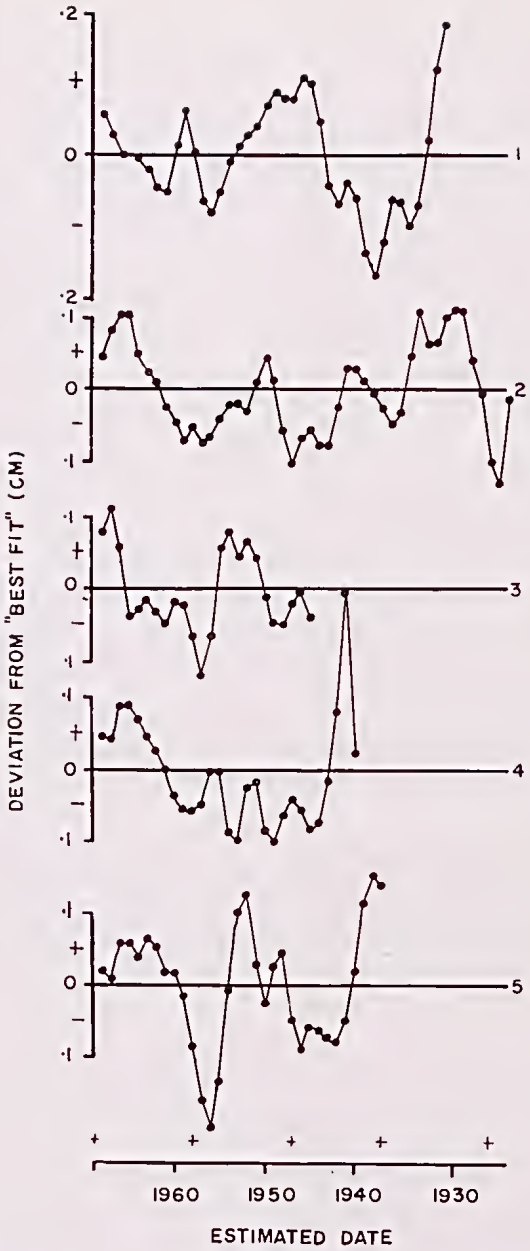

Fig. 2.—The growth ring analysis of five cores taken from trees growing on the north end of Garden Island. The data are smoothed. Each growth ring measurement is plotted as a deviation from the regression line fitted to the data. The time scale assumes that each growth ring represents one year. Addition signs at the base of the graphs represent peaks in sunspot activity.

tainly other conifer species have greater life spans, and the location of stands of *Callitris preissii* which are older than those observed in the present study is desirable for further investigations.

It ean bc seen in Figs. 2 and 3 that there are distinct fluctuations in the width of *Callitris* growth rings. However, the interpretation of these fluctuations is difficult because of the uncertainty of the ehronology. It is possible, at least in some of the curves (e.g. curve 2, Fig. 2) to observe an oscillation in growth rates that is of the order of magnitude of the eleven year sunspot eycle, but further replication of observations and careful statistical analysis is required before correlations can be proved or disproved. The curves in Fig. 3 suggest a period of more rapid growth around the 1920's. This correlates with the end of the decreasing trend in the 80 year sunspot eycle pattern whieh in turn shows a weak but discernable eorrelation with the beginning of a period of generally higher annual rainfall in Perth (annual rainfall 1905-1914: 32.3 in. S.D. 6.5 in., 1915-1924: 38.6 in., S.D. 5.1 in.). The apparently high rate of growth indicated by eurves 3, 4 and 5 at this time may be due, at least in part, to the tendency for rings to be larger towards the eentre, but the trends indicated by curves 1 and 2 elearly suggest that for a period of about a deeade, conditions were such that trees increased in girth to a greater extent than at other times. The establishment of the low closed forests of trees of the age indieated by eores in Fig. 3, curves 3-5, may in fact have resulted from these temporarily more favourable conditions.

No matter what might be the causal factors which initiate world-wide climatic changes (Mitchell, 1965), because of the indirect relationship between large scale atmospheric circulation and plant growth it is elear that the growth of an individual tree is likely to be only weakly eorrelated with these factors. Such correlations may be improved in future studies if more meaningful measures of the environmental conditions are derived that depend on the inter-relationship of a number of factors (e.g. soil moisture conditions during the growing season), but relate more closely to the growth of the tree. See Fritts, 1969, for relevant literature on this subject.

It would appear that, with the precautions and techniques employed in modern growth ring analysis, studies of *Callitris preissii* may reveal information about the past local climates and the fluctuations that may have resulted from world-wide circulation variations or the local influenees of fire and man. The present paper attempts to outline the possibilities that exist in the vicinity of Perth.

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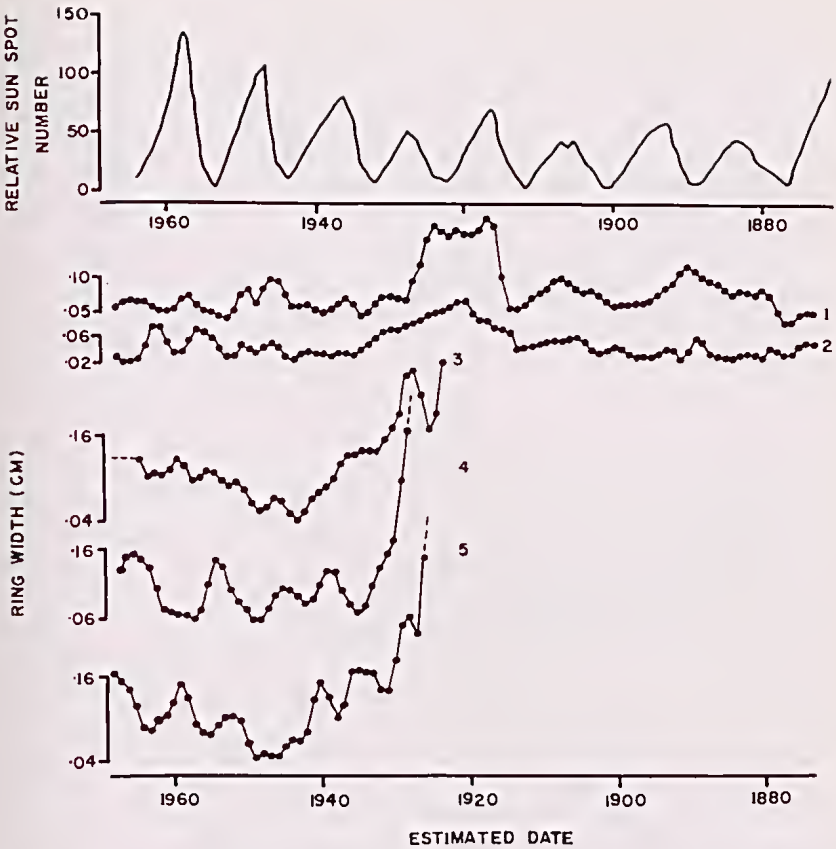

Fig. 3.—The growth ring analysis of five eores taken from trees growing at Naval Base. The data are smoothed, but unlike that in Figure 2, are plotted as aetual ring width against the estimated date. Dotted lines represent parts of the eores where measurement of ring width was diffieult. The upper eurve is a plot of the sunspot aetivity (after Sellers, 1967), and demonstrates the 11, 22 and less aetive part of the 80 year eyeles of aetivity.

A NOTE ON ABORIGINAL ARTIFACTS FROM THE SOUTH BULLSBROOK AREA

By K. AKERMAN, Nedlands

On May 30, 1965, C. P. Johnson and the writer measured an area of five feet square at approximately the eentre of the South Bullsbrook artifaet site described by Butler (1958) and colleeted all surfaee material eontained in the square. As the soil was too damp for sieving, twenty minutes were spent kneading the sand to a depth of six inehes and colleeting the subsurfaee material. From the twelve and a half eubie feet investigated 63 pieees of stone were colleeted.

This material was sorted into three major groups thus: Group 1. Those natural pieees showing no signs of human usage (W.A. Museum Reg. 15878). Group 2. All flakes having the appearanee of being struek;